



**The Former Crawford Station Manufactured Gas Plant
Properties A & B
(XTRA Intermodal)
Chicago, Illinois**

Site Investigation Report

Prepared for

**The Peoples Gas Light
and Coke Company**

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EXECUTIVE SUMMARY

In conformance with the Illinois Environmental Protection Agency (Illinois EPA) Site Remediation Program (SRP), defined in Chapter 35 of the Illinois Administrative Code (IAC), Subtitle G, Waste Disposal, Chapter I: Pollution Control Board, Part 740, The Peoples Gas Light and Coke Company (Peoples Gas) contracted Burns & McDonnell to perform a site investigation (SI) of the former Crawford Station manufactured gas plant (MGP) Properties A & B (XTRA Intermodal portion) [site] in Chicago, Illinois. This SI Report summarizes investigation activities and presents the findings.

The former Crawford Station MGP encompassed 260-acres of land northwest of the intersection of Interstate 55 and Pulaski Avenue. The site consists of the southwestern corner of the former Crawford Station MGP and is the subject of the investigation described in this SI Report. This SI Report specifically excludes the other portions of the former Crawford Station MGP. The site is approximately thirty-five (35) acres in size. The site is west of the South Kostner and 36th Avenue intersection and is used to store intermodal boxes and chassis.

In 1921, the Koppers Company of Pittsburgh and Peoples Gas entered into an agreement whereby Koppers built and financed the Crawford Station MGP. Under the terms of the contract, the Chicago By-Product Coke Company was formed to own and operate the plant. Peoples Gas then bought the gas and coke manufactured at the plant for distribution to consumers. Peoples Gas acquired the Chicago By-Product Coke Company in 1938. The Crawford Station MGP produced coke oven, carbureted water and reformed natural gas. The gas manufacturing processes used at this site resulted in the production of by-products, predominantly coal tars. Production was temporarily halted between 1958 and 1962 and permanently after 1963. Dismantling of the station began in 1956 starting with portions of the coke oven plant. The remainder of the station, including the two 10 million cubic foot gas holders were dismantled and the plant was retired in 1965. Peoples Gas sold 146 of the original 260 acre site to First American Realty Company in 1966.

SI field activities were performed in accordance with an Illinois EPA approved work plan dated October 2000 (Burns & McDonnell 2000). SI field activities were performed in March and May 2001. A total of ninety-four (94) soil probes, three (3) soil borings, and one (1) hand auger were advanced at various locations across the site. Soil samples were collected from various depths within each soil probe and delivered to an analytical laboratory and analyzed for MGP-related constituents and physical properties. Nine (9) soil probe and three (3) soil boring locations were also converted to 2-inch polyvinyl chloride (PVC) monitoring wells and groundwater samples were collected and analyzed for MGP-related constituents.

The following stratigraphic units, listed in descending order from grade, were identified at the site: fill, brown/gray silty clay unit, and gray silty clay unit. Fill materials consisted primarily of sand and gravel with smaller amounts of silt, clay, brick, cinders, and wood. Underlying the fill is up to 14 feet of native brown/gray silty clay. The brown/gray unit ranges from a silty clay unit with some, to a trace of sand and

gravel, with some small fractures. Underlying the brown/gray unit is another native silt/clay unit, presumably the Carmi Member of the Equality Formation. This unit ranges from a silty clay to clay with a trace of sand and fine gravel.

During SI field activities, odors, staining, and small to large amounts of tars were observed in three separate areas at the site. The first area is in the southwest section of the site, is the largest, and was classified as source material. A hard layer of tar saturated soil exists at the surface to about 4 feet below ground surface (bgs), and tar appears within fractures in the brown/gray silty clay. The tar in fractures was typically observed from 8 to 13 feet bgs (averaging about 2 feet thick). The second area is in the north central section of the site, and impacts include odors, staining, and small amounts of free product. This area was also classified as source material. Tar was observed in the fractures of the silty clay from 15.5 feet to 16.5 feet bgs. Green staining and wood fragments with a faint to strong odor were also noticed in this area. The green staining occurred from approximately 7 to 13 feet bgs. The third area is in the northwestern section of the site and was not classified as source material. Coal tar odors and tar were observed in the fractures of the brown/gray silty clay layer from 10.5 to 12 feet bgs. Migration of MGP-related constituents appears to be mainly through fractures in the brown/gray silty clay unit encountered at the site.

Based on an Illinois EPA Tiered Approach to Corrective Action (TACO) Tier 1 evaluation for industrial/commercial properties as defined in 35 IAC Part 742, several MGP constituents exceeded soil screening levels for soil ingestion, soil inhalation, and soil migration to groundwater, and groundwater screening levels for ingestion of Class II groundwater. In general, SVOCs were the only compounds that exceed the screening levels for the soil ingestion exposure route and benzene was the only compound that exceeds the screening level for the soil inhalation exposure route. Benzene, toluene, ethylbenzene, and xylenes (BTEX), SVOCs, styrene, and several metals exceed soil screening levels for the soil migration to groundwater exposure route. Benzene and some SVOCs exceed the groundwater ingestion exposure route.

The overall objective of the former Crawford Station MGP, Properties A & B SI was to determine whether MGP-related constituents are present, and, if present, define the nature and extent of impacted areas. The objectives of the SI were met and the nature and extent of impacted areas were defined. Immediate remedial actions will be addressed in the forthcoming *Interim Remedial Action Plan (IRAP)*. The *IRAP* will present corrective measures proposed to eliminate or prevent exposure to MGP constituents and free product coal tar found at the site. Corrective measures may include removal of source materials and free product coal tar, removal of impacted surface soils, use of an engineered barrier, and/or adherence of existing city ordinances preventing the use of groundwater at the site.

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1.0 SITE CHARACTERIZATION

In conformance with the Illinois Environmental Protection Agency (Illinois EPA) Site Remediation Program (SRP), defined in Chapter 35 of the Illinois Administrative Code (IAC), Subtitle G, Waste Disposal, Chapter I: Pollution Control Board, Part 740, The Peoples Gas Light and Coke Company (Peoples Gas) contracted Burns & McDonnell to perform a site investigation (SI) of the former Crawford Station manufactured gas plant (MGP) Properties A & B (XTRA Intermodal portion) [site] in Chicago, Illinois. This SI Report summarizes SI activities and presents SI findings.

The former Crawford Station MGP encompassed 260-acres of land northwest of the intersection of Interstate 55 and Pulaski Avenue. The site consists of the southwestern corner of the former Crawford Station MGP (Figure 1) and is the subject of the investigation described in this SI Report. The site is approximately thirty-five (35) acres in size. This SI Report specifically excludes the other portions of the former Crawford Station MGP.

1.1 PAST INVESTIGATIONS AND SOURCES CONSULTED OR REVIEWED

Hanson Engineers, Inc. prepared a report entitled "Preliminary Site Investigation Crawford Station" in February 1992 for the entire 260-acre parcel (Hanson 1992). Hanson reached the following conclusions at the end of its investigation:

- Most of the original aboveground structures have been removed from the site.
- No evidence of surface contamination was noted; however, access to the site may have been restricted.
- Facilities which may have impacted the site include railroad tracks, aboveground and underground storage tanks, former oil storage and refining of oil, solvents and gasoline products, an abandoned quarry and a coal fired power plant.
- Public water supply for the site is provided from Lake Michigan.
- Groundwater is not used within a one-mile radius of the site.
- There are no municipal wells within a one-mile radius of the site.
- The current potential for exposure to off-site receptors is minimal.

No previous investigations focused on the XTRA Intermodal portion separately.

1.2 SITE HISTORY

In 1921, the Koppers Company of Pittsburgh and Peoples Gas entered into an agreement whereby Koppers built and financed the Crawford Station MGP. Under the terms of the contract, the Chicago By-Product Coke Company was formed to own and operate the plant. Peoples Gas then bought the gas and coke manufactured at the plant for distribution to consumers. Peoples Gas acquired the Chicago By-Product Coke Company in 1938. Initial facilities at the site included 105 coke ovens (increased to 151 coke ovens between 1948 and 1950), nine water gas sets, and two 10 million cubic foot water-seal gas holders. In the 1930's, a light oil refining plant and a liquefied petroleum gas peak shavings facilities

were added to the MGP, and five of the nine water gas sets were converted to produce reformed natural gas and later oil gas. Forty liquefied petroleum tanks were installed in 1957. The Crawford Station MGP produced coke oven, carbureted water and reformed natural gas. The gas manufacturing processes used at this site resulted in the production of by-products, predominantly coal tars. These by-products were stored in tanks onsite and were frequently sold to other companies for direct use or for conversion into other products. By 1956, the Crawford Station was only used to supply gas and coke when the demand was high. Production was temporarily halted between 1958 and 1962 and permanently after 1963. Dismantling of the station began in 1956 starting with portions of the coke oven plant. The remainder of the station, including the two 10 million cubic foot gas holders, were dismantled and the plant was retired in 1965. Peoples Gas sold 146 of the original 260 acre site to First American Realty Company in 1966.

The site is located on the southwestern portion of the former Crawford Station MGP and is currently used for storage of intermodal boxes for XTRA Intermodal. The historical structures or features of the site included the former Chicago and Illinois Western Railroad on the western portion of the site, former coke and coal storage on the southeast portion of the site, a former fork of the Chicago River (which has been filled in and may act as a preferential pathway) and several former buildings including a paint shop, a carpenter shop, a machine shop and an electrical repair shop/storage building. Appendix A contains Sanborn Maps that show historical structures and features. Figure 2 presents the location of former MGP structures.

1.3 SITE DESCRIPTION

1.3.1 Site Location and Legal Description

The site is located in the West Township of the City of Chicago, Illinois in the County of Cook and is approximately thirty-five (35) acres in size. Specifically, the site is immediately east of the Chicago and Western Indiana Belt Line Railroad and north of the Chicago Ship and Sanitary Canal (Figure 1). Appendix B contains the legal description for the site.

1.3.2 Site Physiography and Site Topography

The site is contained completely within the former Crawford Station MGP site, and makes up a portion of the western boundary of the entire 260-acre property. The site is west of the South Kostner and 36th Avenue intersection and is used to store intermodal boxes and chassis.

According to the United States Geological Survey 7.5-Minute Quadrangle, (1993) the site is at an elevation of approximately 600 feet above mean sea level. The site is mostly flat with a sharp depression along the western property boundary of approximately 5 feet (adjacent to the railroad tracks). Regional surface water flow appears to be toward the south, toward the Chicago Sanitary and Ship Canal, which is located approximately 600 feet south of the site.

1.3.3 Potential Migration Pathways and Exposure Routes

Potential migration pathways and exposure routes identified at the site include underground utilities, a filled in former fork of the Chicago River, leaching of MGP constituents into subsurface water bearing unit(s), and direct ingestion or inhalation of near surface MGP constituents in soil. The site is primarily gravel covered and therefore all three soil Illinois EPA exposure routes (ingestion, inhalation, and migration to groundwater for Class II groundwater) will apply at this site. Groundwater ingestion for Class II groundwater also applies at the site.

1.3.4 Published Geological Information

Burns & McDonnell reviewed several published documents in an effort to understand the regional geological setting in the area of the site. The Geologic Map of Illinois (Willman 1967) indicates that bedrock beneath the site is Silurian Dolomite. Based on this map, the approximate depth below ground surface (bgs) to the bedrock surface is generally greater than 50 feet and glacial deposits overlie bedrock. The *Quaternary Deposits of Illinois* (Lineback 1979) map indicates that the surface soil at the site is the Carmi Member of the Equality Formation, which is described as largely quiet water sediments deposited in ancient lake Chicago. The *Quaternary Deposits* map also indicated that the Mackinaw Member of the Henry Formation might also be on or near the site. The Carmi Member is described as well bedded silt and some clay. The Mackinaw Member of the Henry Formation consists of sand, pebbly sand, and gravel deposited as outwash valley trains leading outward from the Wisconsinan glacier fronts (Willman 1975).

The publication entitled *Stack Unit Mapping of Geologic Materials in Illinois to a Depth of 15 Meters* (Berg and Kempton 1988) indicates that site soils consist of deposits less than 20 feet thick of the silty Carmi member of the Equality Formation overlying more than 20 feet of clay deposits of the Wedron Formation, which overlies silurian and some devonian rocks that are mainly dolomite. *Plate 1: Land Burial of Municipal Wastes* and *Plate 2: Surface and Near-Surface Waste Disposal* contained in the publication entitled *Potential for Contamination of Shallow Aquifers in Illinois* (Berg and Kempton 1984) rate the aquifer susceptibility for the site as C1 and D2, respectively. For land burial of municipal wastes, a rating of C1 indicates permeable bedrock within 20 to 50 feet of surface, overlain by till or other fine-grained material. For surface and near-surface waste disposal, a rating of D2 suggests uniform, relatively impermeable silty or clayey till at least 20 feet thick and no evidence of interbedded sand and gravel. These aquifer ratings suggest that near surface waste disposal exhibits a low likelihood of impacting shallow groundwater aquifers beneath the site, but that land burial of municipal waste exhibits an intermediate likelihood of impacting groundwater.

1.3.5 Hydrogeology

The City of Chicago's groundwater ordinance prohibits the use of groundwater for consumption within the city limits. The *Summary of the Geology of the Chicago Area* (Willman 1971) describes shallow groundwater in the Chicago area as being limited to sand and gravel horizons in unconsolidated soil and fractured bedrock aquifers. The unconsolidated materials in this area consist primarily of clay with

isolated lenses of sand material and are not considered aquifers. In the Chicago area, bedrock aquifers are found within Silurian, Ordovician and Cambrian formations, which are greater than 50 feet bgs.

Precipitation and surface seepage recharge shallow groundwater aquifers in the Chicago land area. The publication entitled *Potential for Contamination of Shallow Aquifers in Illinois* provides estimated hydraulic conductivities of typical geological materials in Illinois. Geological materials encountered at the site include sand and gravel, silty sand, silt and clay. Estimated hydraulic conductivities for these soil types are as follows:

- | | |
|-------------------------|---|
| • Clean sand and gravel | 1×10^{-3} cm/sec |
| • Silty sand | 1×10^{-5} to 1×10^{-3} cm/sec |
| • Silt | 1×10^{-6} to 1×10^{-4} cm/sec |
| • Clay till | 1×10^{-9} to 1×10^{-7} cm/sec |

The Chicago Ship and Sanitary Canal (Canal) is the closest surface water body located adjacent to the southern boundary of the site. According to the Illinois EPA, water quality within the Canal is generally poor. Survey stations upstream and downstream of the site indicate that the greatest impact to water quality is from fecal coliform concentrations due primarily to waste water treatment discharges. Natural surface water runoff flows in multiple directions. However, surface water is primarily directed toward the canal. Multiple storm sewer inlets are located around the site which direct most of the surface water into the City of Chicago's combined sewer system.

According to the Federal Emergency Management Agency (FEMA), the site is not within the limits of the 100-year floodplain. A floodplain exists approximately 30 feet north of the Canal. No wetland areas are shown within the boundaries of the site on the National Wetland Inventory maps developed by the U.S. Fish and Wildlife Service (internet map). However, Hanson sited two possible wetland areas, located along the western and southern site boundaries that appear to be drainage ditches (Hanson 1992). The Illinois Department of Conservation's Natural Heritage Database lists no federal or state threatened and endangered species or pristine natural areas occurring in the vicinity of the site.

1.3.6 Current Use of the Site and Surrounding Areas

Zoning at the site is Motor Freight Terminal District (C4) (City of Chicago 1999). The surrounding area is primarily the zoned the same (C4) with manufacturing and other commercial properties in the area; residential areas are approximately 3/4 mile northwest of the site (Figure 3). A majority of the ground surface is covered with gravel, concrete and building structures.

1.3.7 Future Use of the Site and Surrounding Areas

The site is currently used for storage of intermodal boxes, chassis and semi-trailers. The future use of the site is anticipated to continue as storage of intermodal boxes, chassis and semi-trailers. The surrounding property and site use is not expected to change appreciably in the foreseeable future.

1.3.8 Meteorology

Weather in the area of the site is continental in nature with cold dry winters and warm humid summers. Short duration, relatively large magnitude changes in temperature, humidity, precipitation, and wind direction are common. Annual mean weather conditions are as follows:

Precipitation	37.2 Inches
Temperature	51.8 Degrees Fahrenheit
Last Spring Freeze	April 9
First Fall Freeze	Oct. 28

Average temperatures are warmest during the month of July at 75.4 degrees Fahrenheit and coolest during the month of January at 24.7 degrees Fahrenheit. Precipitation varies from a low of 1.5 inches in February to a high of 4.1 inches in June. Snowfall occurs mostly between late October and early April. Highest snowfall accumulation occurs in February, which has an average total monthly snowfall of 10 inches.

Wind direction is usually from the south, southwest, or west. Wind in the area of the Site is from the south, southwest, or west direction approximately 47.1 percent of the time. The most common wind direction is south, which occurs 11.9 percent of the time. Mean wind speed in the prominent wind direction (south) is 10.6 miles per hour.

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2.0 SITE SPECIFIC SAMPLING PLAN

SI field activities were performed in accordance with the Illinois EPA approved *Work Plan for Former Crawford Station Site (XTRA Intermodal Portion) Chicago, Illinois* dated October 2000 (Burns & McDonnell 2000). In general, field activities were completed as outlined in the work plan, except where field conditions warranted changes (e.g. boring/sample location(s) added, boring/sample location(s) moved due to field constraints, etc.). SI field activities were performed during two events, the first was conducted between March 12 and March 30, and the second between May 22 and May 24, 2001. Due to a high density of semi-trailers that could not be moved in the northern most portion of the site, the second mobilization was required to complete the work in that portion of the site.

2.1 SOIL PROBE SAMPLING PROCEDURES

A total of ninety-four (94) soil probes, three (3) soil borings, and one (1) hand auger were advanced at various locations at the site. Figure 4 shows the soil probe locations. Surface and subsurface soil samples were collected from probe locations using direct push sampling equipment and three (3) with hollow stem augering (HSA) equipment. Probe locations were continuously sampled using 4-foot long 1.5-inch diameter stainless steel sample tubes lined with acetate liners. Two-foot split spoon samplers were used to collect continuous samples from the soil borings. Each sample interval was field screened for volatile organic compounds (VOCs) using a photo-ionization detector (PID), and select samples were collected for laboratory analysis. Soil cuttings generated during sampling activities were collected in 55-gallon drums.

A stainless steel knife was used to facilitate sample collection from each acetate liner. Surface vegetation and/or carryover material from previous sampling intervals were removed before sampling. Soil samples were picked up at the site by an analytical laboratory and analyzed for MGP-related constituents and physical properties. Soil samples to be analyzed for VOCs were collected as soon after sample retrieval as possible in accordance with SW-846 Method 5035 using the following Powerstop Handle™ sampling procedures:

- An EasyDraw Syringe™ was inserted into the Powerstop Handle™.
- The EasyDraw Syringe™ was then pushed into a freshly exposed surface of soil until the syringe was full.
- The syringe was then removed from the handle and its contents inserted into pre-preserved 40-ml vial(s).

Soil samples to be analyzed for semivolatile organic compounds (SVOCs), priority pollutant metals, and total cyanide were collected after collecting VOC samples. Samples were taken directly from the acetate liner or the split-spoon sampler and placed in clean sampling jars and the jar lids secured. All soil samples were designated with a unique identifier and were placed in a cooler, packed with ice, and received by the subcontracted laboratory under proper chain-of-custody procedures.

Visual observations of soil type and condition were recorded on boring log forms. Field classification included principal and minor constituents, observed moisture (if any), soil color, soil texture, PID readings and impacts to the soil including signs of coal tar if observed.

After completion of soil probing activities, probe and boring locations were measured out to permanent site features, and measurements were recorded. Soil probe, hand auger and boring holes were backfilled to 6 inches below ground surface (bgs) with bentonite chips. The remaining 6 inches were filled with topsoil or patched with asphalt.

2.2 SURFACE SOIL INVESTIGATION

Ninety-one (91) surface soil samples from soil probes SP001 through SB098 were collected to characterize possible surface soil impacts at the site. Samples were obtained from within the upper three (3) feet of the soil horizon. Figure 4 presents soil probe locations. Table 1 presents the surface soil sample depths and associated chemical analyses. The following subsections describe sampling locations, depths, and chemical analyses performed on surface soil samples.

2.2.1 Surface Soil Sample Location and Depth

Surface soil samples were collected from varying depths within the upper 3 feet of the sites soil horizon. Samples were collected from 0 to 3 inches bgs, 0 to 1 foot, 1 foot to 2 feet, or 2 feet to 3 feet bgs. Surface soil samples were collected from SP001 through SP098, except at locations SP021, SP024, SP027, and SP029.

2.2.2 Chemical Analyses

Table 1 presents the analyses performed on each surface soil sample. In general surface soil samples were analyzed for the following parameters:

- Target Compound List (TCL) VOCs, SW-846 Method 5035/8260B
- TCL SVOCs, SW-846 Method 8270C
- Priority Pollutant Metals: antimony, arsenic, beryllium, cadmium, chromium, copper, lead, mercury, nickel, selenium, silver, thallium, and zinc; SW-846 6000/7000 series
- Total Cyanide, SW-846 Method 9010B/9014

2.3 SUBSURFACE SOIL INVESTIGATION

A total of sixty-five (65) subsurface soil samples were collected from the 98 soil probes/borings. Subsurface soils were visually characterized and scanned for MGP-related constituents using field instruments and field personnel's olfactory senses. Appendix C presents soil boring log forms which summarize these observations. Subsurface samples were analyzed for source material and MGP-related constituents. The following subsections describe sampling locations, depths and chemical and physical analyses performed on subsurface soil samples.

2.3.1 Subsurface Soil Sample Locations and Depths

Subsurface soil samples were collected from all soil borings except SP003, SP005, SP006, SP031, SP032, SP034, SP037, SP039, SP041, SP044, SP045, SP047, SP050 through SP052, SP057, SP064, SP069, SP074, SP076, SP083, SP085, SP089, SP091 through SP092, and SP096. Subsurface soil samples were collected at the other probe locations at varying depths from 3 feet bgs to above the water table or where impacted conditions were observed below the water table, based on field personnel judgement.

Subsurface soil samples were collected at the locations listed above which are shown in Figure 4.

2.3.2 Chemical Analyses

Table 2 presents the analysis performed on each soil sample. In general, subsurface soil samples were analyzed for TCL VOCs, TCL SVOCs, priority pollutant metals, and total cyanide and in select samples the following source material parameters were analyzed for:

- Toxicity characteristic leaching procedure (TCLP) VOCs
- TCLP SVOCs
- TCLP metals
- Polychlorinated biphenyls (PCBs)
- Cyanide (reactive)
- Sulfide (reactive)
- Pesticides
- Soil pH

2.3.3 Physical Testing

Physical laboratory tests were performed on soil samples collected from SP074-001, SP068-002, and SP040-002. In general, soil samples were tested for the following physical parameters:

- moisture content
- percent organic carbon
- grain-size distribution (subsurface sample only)

2.4 GROUNDWATER INVESTIGATION

Twelve soil probe/boring locations were converted to 2-inch groundwater monitoring wells. Figure 4 depicts the monitoring well locations. Appendix C presents the well construction diagrams. Monitoring wells were installed with a truck-mounted hollow-stem auger rig with 4 1/4" augers, and constructed of 2-inch diameter polyvinyl chloride (PVC) screen and casing materials. The annulus around each screen was backfilled with sand filter pack to 2 feet above the top of the screened interval and sealed with an approximately 3.5-foot bentonite seal. A small amount of sand (approximately 3 inches) was added above the bentonite seal before the concrete pad and flush mounted well box were added to finish each monitoring well. Each location was developed using a decontaminated, 12-volt submersable pump and sampled using a peristaltic pump. One groundwater sample was collected from each well, except MW011 which was dry at the time of sampling, and analyzed for TCL VOCs, TCL SVOCs, priority pollutant metals, and total and amenable cyanide.

2.4.1 Field Measurements

Static water level in each monitoring well was measured using a hand held electric water level indicator marked in increments of 0.05 foot, with measurements recorded to the nearest 0.01 foot. All water levels were collected from an established survey point marked on each monitoring well casing and related to a relative elevation established onsite. Table 3 presents static water level measurement data.

2.4.2 Groundwater Sampling Procedures

A peristaltic pump with polyethylene tubing was used to purge standing water from the monitoring well prior to sample collection. Between one to three well volumes was removed depending on water recover rates of each monitoring well. Groundwater was withdrawn from the top of the standing water table to ensure that representative formation water was drawn into the casing and to prevent disturbance of sediment that may be present at the bottom of the casing.

After purging, groundwater samples were collected once a sufficient volume for sampling was available. A peristaltic pump with polyethylene tubing was used to collect groundwater samples from each monitoring well. The tubing was slowly lowered into the monitoring well, the pump was turned on, and groundwater was transferred directly into sample containers. New tubing was used in each monitoring well.

All groundwater samples were designated with a unique identifier and were placed in a cooler, packed with ice, and picked up at the site or the Burns & McDonnell office in Oak Brook, Illinois by a subcontracted laboratory under proper chain-of-custody procedures.

2.4.3 Chemical Analyses

One groundwater sample was collected from each of the eleven (11) monitoring wells and analyzed for TCL VOCs, TCL SVOCs, amenable and total cyanide, and priority pollutant metals, as presented in Table 4.

* * * * *

3.0 FIELD OBSERVATIONS

This section presents field observations made during SI activities including surface and subsurface soil sampling, installation of groundwater monitoring wells, and groundwater sampling activities.

3.1 SITE GEOLOGY

During the SI, 98 soil probes ranging from 1 to 24 feet bgs were advanced at the site. Site geology was characterized during advancement of these soil probes and recorded on soil probe log forms. Appendix C presents the soil probe logs. The following stratigraphic units, listed in descending order, were identified at the site: fill, brown/gray silty clay, gray silty clay. Asphalt and a gravel/sand subbase are at the surface in a few locations, and a sand layer is located above the brown/gray silty clay layer along the western edge of the property.

Seven geologic cross-sections showing subsurface soils encountered at the site were prepared in order to define the two larger areas of impact on the site. Five are located in the southwest section of the property and the other two cross-sections are located in the north central portion of the site (Figure 5).

The following subsections describe each stratigraphic unit.

3.1.1 Fill Unit

The site contains 0 to 9 feet of fill material, averaging approximately 6.5 feet in thickness. The fill consisted primarily of gravel and sand with smaller amounts of silt, clay, bricks, cinders, glass, and wood. Asphalt, where present, was 6 inches thick with up to 2 feet of gravel/sand subbase.

3.1.2 Brown/Gray Silty Clay Unit

Underlying the fill is a native layer of brown to brown/gray silty clay, up to 14 feet thick. The unit is a silty clay with a trace to some sand and gravel and often has orange mottling. The silty clay layer was seen in all deep soil probe locations across the site.

3.1.3 Gray Silty Clay Unit

Underlying the brown/gray silty clay layer is a native gray silty clay unit presumably the Carmi Member of the Equality Formation. The top of the silt/clay unit was encountered from 10 to 15 feet bgs, averaging approximately 13 feet bgs. The silty clay unit is consistently made of equal parts silt and clay with traces of sand and gravel. The silt/clay unit was encountered in all soil probes across the site with the exception of the shallow probe locations and areas where probe refusal was encountered.

3.2 SITE HYDROGEOLOGY

During SI field activities, water was encountered in each probe location. The fill material acts as the main waterbearing unit for the site with small sand lenses in the silty clay also contributing water. Nine soil

probes had monitoring wells installed adjacent to them. Additionally, three soil borings were converted into monitoring wells. Table 3 contains the water level measurement data for each well. Based on the water level measurements, the groundwater flow direction is east, northeast.

Recharge of the fill and silty clay units is expected to be local and most likely depends on precipitation. Depths to the tops of these units average 0 to 2 feet for the fill and 3 to 9 feet for the silty clay. The soil classification results of the grain size sample indicated 19% sand and 81% fines (silt and clay) and do not meet the definition of a Class I aquifer, as defined in 35 IAC, Subtitle F, Chapter I, Part 620 – Groundwater Quality, Section 210. Additionally, recharge was found to be relatively poor during the development of each of the monitoring wells. Therefore, the groundwater is considered to be Class II in accordance with the regulations.

3.3 AREAS OF IMPACT

During SI field activities, odors, staining, and large to small amounts of tars were observed in three separate areas at the site. The largest area is located along the southwestern property boundary where a hard layer of tar saturated soil exists at the surface to about 4 feet bgs, and tar appears within fractures in the brown/gray silty clay layer. The tar in fractures was typically observed from 8 to 13 feet bgs (averaging about 2 feet thick). All soil intervals were screened with a PID as described in section 2.1. PID readings were higher in the silty clay layer than near the surface, and ranged from 0 to 117 parts per million (ppm), with most readings under 40 ppm.

The second area containing odors, staining, and small amounts of free product is located in the north central portion of the site. Tar was observed in the fractures of the silty clay from 15.5 feet to 16.5 feet in SP058, with a maximum PID reading of 158 ppm. Green staining and wood fragments with a faint to strong odor were also noticed in this area. The green staining occurred from approximately 7 feet to 13 feet in the samples. PID readings from the green stained material ranged from 0 to 128 ppm, with most readings between 10 and 40 ppm.

The third and smallest area of impact is along the western boundary of the site centered around SB086/MW002 (Figure 7). Coal tar odors and tar were observed in the fractures of the brown/gray silty clay layer from 10.5 feet to 12 feet bgs. PID readings of this zone ranged from 1.2 ppm to 3.4 ppm.

3.4 PRESENTATION OF THE ANALYTICAL RESULTS

This section summarizes MGP-related constituents encountered at the site. Information presented herein is based on field observations, chemical analyses and physical testing of soil and groundwater samples. Tables 5 through 9 present soil and groundwater analytical data results.

PDC Laboratories, Inc. of Peoria, Illinois performed priority pollutant metals analysis on soil samples and all analyses on groundwater samples. STAT Analysis Corporation, of Chicago, Illinois, performed the remaining analyses on soil samples and on potential source material. The laboratories also reduced and validated analytical results in accordance with approved Illinois EPA Site Remediation Program

analytical laboratory procedures. The report entitled *Former Crawford Station Manufactured Gas Plant Properties A & B (XTRA Intermodal Portion) Site Investigation Sampling Data* (Burns & McDonnell June 2001) contains a complete set of laboratory analytical result data sheets, data validation memoranda and summary tables of validated data.

Analytical results are presented in the following categories to aid in interpretation:

- Surface soil results.
- Subsurface soil results.
- Groundwater results.

3.4.1 Surface Soil Analytical Results

This section presents surface soil analytical results. All surface soil samples were collected between 0 and 3 feet bgs.

3.4.1.1 Surface Soil TCL VOC

TCL VOCs were not detected in 41 of the 94 surface soil samples (Table 5). The TCL VOCs typically associated with MGP impacted soil are benzene, ethylbenzene, toluene, and total xylenes (commonly referred to as BTEX). The following bullets summarize detected BTEX concentrations:

- Benzene was detected in 16 surface samples, ranging from 0.006 mg/kg at SP097 to 116 mg/kg at SP002.
- Ethylbenzene was detected in six (6) surface samples, ranging from 0.009 mg/kg at SP037 to 16.6 mg/kg at SP065.
- Toluene was detected in nine (9) surface samples, ranging from 0.007 mg/kg at SP012 to 104 mg/kg at SP011.
- Total xylenes were detected in thirteen (13) surface samples, ranging from 0.005 mg/kg at SP098 to 145 mg/kg at SP011.

Additionally, acetone was detected in thirty-four (34) surface samples; 2-butanone was detected in four (4) surface samples; carbon disulfide was detected in six (6) surface samples; cis-1,2-dichloroethene was detected in one (1) surface sample; styrene was detected in three (3) surface samples and 1,1,1-trichloroethane in one (1) surface sample.

3.4.1.2 Surface Soil TCL SVOC

TCL SVOCs were not detected in 21 of the 94 surface soil samples (Table 5). A total of 24 different SVOCs were detected in the surface soils. Concentrations of detected compounds ranged from 0.372 mg/kg (benzo(b)fluoranthene, SP074) to 22,400 mg/kg (naphthalene, SP003). The most frequently detected SVOC were PAHs including benzo(a)anthracene, benzo(k)fluoranthene, chrysene, fluoranthene, phenanthrene, and pyrene. Benzo(a)pyrene was detected in 55 samples ranging from 0.370 mg/kg at SP072 to 1,780 mg/kg at SP040. The highest detected concentrations of each compound were in the two impacted areas in the southwest and north central sections of the site.

3.4.1.3 Surface Soil Priority Pollutant Metals and Total Cyanide

At least one priority pollutant metal was detected in each surface sample (Table 6). A total of 13 different metals were detected. Antimony and thallium were non-detect in all surface soils. The following bullets summarize detected concentrations:

- Arsenic: 1.5 mg/kg at SP057 to 140 mg/kg at SP062 (with the majority of the concentrations below 13 mg/kg).
- Beryllium: 0.15 mg/kg at SP085 to 3.6 mg/kg at SP043.
- Cadmium: 1.2 mg/kg at SP030 to 14 mg/kg at SP004.
- Chromium: 3 mg/kg at SP002 to 140 mg/kg at SP041.
- Copper: 6.3 mg/kg at SP085 to 200 mg/kg at SP004.
- Lead: 0.86 mg/kg at SP076 to 480 mg/kg at SP003.
- Mercury: 0.045 mg/kg at SP070 to 5.8 mg/kg at SP003.
- Nickel: 8.8 mg/kg at SP042 to 74 mg/kg at SP083.
- Selenium: 1.3 mg/kg at SP037 to 16 mg/kg at SP062.
- Silver: 4.2 mg/kg at SP065 to 4.4 mg/kg at SP010.
- Zinc: 17 mg/kg at SP066 to 410 mg/kg at SP062.
- Total cyanide: 0.26 mg/kg in SP073-001 to 66.9 mg/kg in SP005-001.

3.4.1.4 Surface Soil Potential Source Material

A sample (HA001) was collected using a hand auger and tested as a potential source material (Table 7). The sample was non-detect for PCBs, TCLP VOCs (except benzene, which is 0.375 mg/L), TCLP SVOCs (except o-Cresol and m&p-Cresol, 0.163 and 0.530 mg/L, respectively), TCLP Metals (except barium and lead, 0.330 and 0.021 mg/L, respectively), and reactive cyanide and sulfide.

3.4.2 Subsurface Soil Analytical Results

This section presents the subsurface soil analytical results. Subsurface soil samples were collected at varying depths from 3 feet bgs to the water table or where potentially impacted conditions were observed below the water table.

3.4.2.1 Subsurface Soil TCL VOC

VOCs were not detected in 20 of the 68 subsurface soil samples. BTEX compounds were the most common VOCs detected. Additionally, acetone was detected in fifteen (15) subsurface samples; 2-butanone was detected in six (6) subsurface samples; carbon disulfide was detected in five (5) subsurface samples; carbon tetrachloride was detected in one (1) subsurface sample; and styrene was detected in ten (10) subsurface samples. The following bullets summarize detected BTEX concentrations:

- Benzene: 0.006 mg/kg at SP071 to 519 mg/kg at SP058.
- Ethylbenzene: 0.006 mg/kg at SP030 to 132 mg/kg at SP066.
- Toluene: 0.005 mg/kg at SP072 to 600 mg/kg at SP058.
- Total xylenes: 0.016 mg/kg at SP072 to 798 mg/kg at SP058.

Additionally, acetone was detected in seventeen (17) subsurface samples; 2-butanone was detected in five (5) subsurface samples; carbon disulfide was detected in five (5) subsurface samples; carbon tetrachloride was detected in one (1) subsurface sample; and styrene was detected in ten (10) subsurface samples.

3.4.2.2 Subsurface Soil TCL SVOC

SVOCs were not detected in 23 of the 68 subsurface soil samples (Table 5). PAHs, including acenaphthylene, anthracene, benzo(a)anthracene, benzo(k)fluoranthene, benzo(a)pyrene, chrysene, fluoranthene, fluorene, phenanthrene, and pyrene, were the most frequently detected SVOCs in subsurface soil samples. Concentrations of the detected compounds range from 0.349 mg/kg (fluoranthene and benzo(g,h,i)perylene, SP072) to 17,700 mg/kg (naphthalene at SP066) with the majority under 1,000 mg/kg.

The highest concentrations of SVOCs in the subsurface samples were detected in the impacted area in the southwest portion of the site, where tar was found in fractures in the silty clay.

3.4.2.3 Subsurface Soil Priority Pollutant Metals and Total Cyanide

Each of the subsurface samples had at least one metal detected and a total of 27 subsurface samples were non-detect for total cyanide (Table 6). Antimony was non-detect in every sample, silver was detected in one sample, and thallium was detected in three samples. The following bullets summarize detected concentrations:

- Arsenic: 2.6 mg/kg at SP068 to 520 mg/kg at SP026.
- Beryllium: 0.2 mg/kg at SP048 to 7.2 mg/kg at SP035.
- Cadmium: 1.6 mg/kg at SP033 to 6.8 mg/kg at SP066.
- Chromium: 4.3 mg/kg at SP066 to 170 mg/kg at SP073.
- Copper: 9.8 mg/kg at SP009 to 150 mg/kg at SP075.
- Lead: 4.3 mg/kg at SP009 to 550 mg/kg at SP059.
- Mercury: 0.064 mg/kg at SP056 to 48 mg/kg at SP048.
- Nickel: 11 mg/kg at SP009 to 54 mg/kg at SP075.
- Selenium: 1.4 mg/kg at SP004 to 11 mg/kg at SP058.
- Silver: 9.4 mg/kg (SP066).
- Thallium: 4 mg/kg in SP042 to 490 mg/kg in SP026.
- Zinc: 9.4 mg/kg at SP087 to 3,000 mg/kg at SP066.
- Total cyanide: 0.35 mg/kg in SP038-002 to 449 mg/kg in SP058-002.

3.4.2.4 Subsurface Soil Potential Source Material

Seven (7) subsurface soil samples were selected as potential source material samples based on field observations. These seven samples were analyzed for soil pH, pesticides/PCBs, and reactive cyanide; along with TCL VOCs, TCL SVOCs, priority pollutant metals, and total cyanide. All seven samples

were non-detect for pesticide/PCBs and reactive cyanide. Soil pHs ranged from 8.41 at SP008-002 to 5.76 at SP058-002, with most pH values greater than 8.0.

3.4.3 Groundwater Analytical Results

This section presents groundwater analytical results. One groundwater sample was collected from each temporary piezometer, except from MW011 (which was dry at the time of sampling) and analyzed for priority pollutant metals, cyanide (total & amenable), TCL VOCs and TCL SVOCs.

3.4.3.1 Groundwater TCL Volatiles

TCL VOCs were not detected in four (4) of the eleven (11) groundwater samples (Table 9). Benzene was detected in two samples at concentrations ranging from 0.007 mg/L to 0.16 mg/L in MW002 and MW004 respectively. Toluene, ethylbenzene, and xylenes (total) were detected in the MW004 sample at concentrations of 0.14 mg/L, 0.044 mg/L, and 0.18 mg/L, respectively. Ethylbenzene and xylenes (total) were detected in the MW009 sample at 0.022 mg/L and 0.016 mg/L, respectively.

3.4.3.2 Groundwater TCL Semivolatiles

TCL SVOCs were not detected in seven (7) of the groundwater samples (Table 9). Samples from MW002, MW006, and MW009 had eleven (11) SVOC constituents detected, ranging from 0.00012 mg/L (chrysene in MW009) to 0.42 mg/L (naphthalene) in the MW009 sample. Seventeen (17) SVOCs were detected in the MW004 sample ranging from 0.001 mg/L (indeno(1,2,3-cd)pyrene) to 4.8 mg/L (naphthalene).

3.4.3.3 Groundwater Priority Pollutant Metals

At least one priority pollutant metal was found in ten (10) of the eleven (11) groundwater samples (Table 10). Antimony, beryllium, cadmium, and silver were non-detect in all of the eleven (11) groundwater samples. The following bullets summarize the detected concentrations:

- Arsenic: Detected in three (3) samples ranging from 0.0079 mg/L to 0.018 mg/L.
- Chromium: Detected in one (1) sample at 0.056 mg/L.
- Copper: Detected in three (3) samples ranging from 0.0066 mg/L to 0.065 mg/L.
- Lead: Detected in six (6) samples ranging from 0.0026 mg/L to 0.01 mg/L.
- Mercury: Detected in one (1) sample at 0.00056 mg/L.
- Nickel: Detected in four (4) samples ranging from 0.011 mg/L to 0.092 mg/L.
- Selenium: Detected in six (6) samples ranging from 0.0076 mg/L to 0.079 mg/L.
- Thallium: Detected in four (4) samples ranging from 0.0027 mg/L to 0.01 mg/L.
- Zinc: Detected in nine (9) samples ranging from 0.021 mg/L to 0.104 mg/L.

3.4.3.4 Groundwater Total and Amenable Cyanide

Amenable cyanide was non-detect in all eleven (11) groundwater samples, and total cyanide was non-detect in three (3) of the samples (Table 10). Total cyanide concentrations ranged from 0.016 mg/L at MW005 to 3.5 mg/L at MW009.

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4.0 ENDANGERMENT ASSESSMENT

4.1 RECOGNIZED ENVIRONMENTAL CONDITIONS

Three areas of potential source material were identified at the site. The first area is in the southwest section of the site and is located in surface and subsurface soil. The second area is in the north central section of the site and impacts are found in the subsurface soil. The third area is in the northwestern section of the site with impacts found in the subsurface soil. Figure 7 presents the significant findings at the site.

MGP constituents were observed at varying degrees in soil and groundwater samples obtained from the site. Based on soil sample results, the highest MGP impacts appear to be in the southwest corner of the property in and around an area where visual tar was observed at the ground surface.

4.2 IDENTIFICATION AND EVALUATION OF EXPOSURE ROUTES

This section compares analytical data results from the site to Illinois EPA Tier 1 industrial/commercial screening levels. The Illinois EPA developed a three-tiered procedure for evaluating data and developing site remediation objectives based on risks to human health and future site use (Illinois EPA 2001). The first tier, Tier 1, compares concentrations of chemicals detected at the site to established screening levels. Tier 1 screening levels are based on conservative assumptions and have no site-specific information factored into their development.

In a Tier 1 screening, both soil and groundwater data are evaluated. Soil data is compared to screening levels for three separate exposure routes: 1) soil ingestion, 2) soil inhalation and 3) soil migration to groundwater for Class II groundwater. Groundwater data from the site is compared to Tier 1 screening levels for the groundwater ingestion exposure route for Class II groundwater.

Tier 1 values and analytical data screening tables are found in Tables 11 through 14.

4.2.1 Soil Ingestion Exposure Route

The Tier 1 soil ingestion exposure route was evaluated with soil samples collected between 0 and 3 feet bgs. Table 11 presents data screened against soil ingestion Tier 1 screening levels for industrial/commercial properties.

Of the eighty-one (81) samples collected, none of the samples exceeded the TACO Tier 1 industrial/commercial screening levels for TCL VOCs or total cyanide. Forty-seven (47) of the samples, however, exceed at least one TCL SVOC screening level. The only SVOCs with exceedences were benzo(a)anthracene, benzo(b)fluoranthene, benzo(k)fluoranthene, benzo(a)pyrene, chrysene, dibenzo(a,h)anthracene, indeno(1,2,3-cd)pyrene and chrysene. Benzo(a)pyrene was detected above the TACO screening level in 41 of the 43 samples. Benzo(a)pyrene exceedence levels ranged from 0.824 mg/kg in SP029-001 and 1780 mg/kg in SP040-001. The other PAHs exceeded TACO Tier 1 in a

maximum of 31 samples. Arsenic, beryllium, and lead are the only priority pollutant metals with exceedences of the Tier 1 ingestion screening levels. Arsenic or beryllium exceeded the screening level in all but six (6) of the 89 surface soil samples, with a majority of the samples exceeding for arsenic. Lead exceeded the screening level in the SP003-001 sample at a level of 480 mg/kg.

4.2.2 Soil Inhalation Exposure Route

The Tier 1 inhalation exposure route was evaluated with soil samples collected between 0 and 10 feet bgs or the water table (whichever occurs first). Table 12 presents data screened against inhalation Tier 1 screening levels for industrial/commercial properties.

Out of the 131 samples screened, there were no exceedences of the Tier 1 screening levels for TCL SVOCs, priority pollutant metals or total cyanide. Eleven (11) of the samples exceeded the screening level for benzene, the only TCL VOC that exceeded the screening levels. Benzene exceedence levels ranged from 3.33 mg/kg in SP033-002 to 130 mg/kg in SP066-002.

4.2.3 Soil Migration to Groundwater Exposure Route

The Tier 1 soil migration to groundwater exposure route was evaluated with soil samples collected from above the water table based on Class II groundwater. Section 3.2 presents the rationale for the Class II groundwater determination. Measured values for pH ranged from 5.76 at SP058-002 to 8.41 at SP008-002, with most pH values greater than 8.0. A pH value of 8.26 was obtained from an unimpacted sample at SP017-002, which best represented the natural soil at the site, and was used to determine the pH specific screening levels for inorganics. Samples were analyzed for total metals; not toxicity characteristic leaching procedure (TCLP) and/or synthetic precipitation leaching procedure (SPLP) metals. Table D in Appendix B of the approved TACO regulations does not present screening values for pH exceeding 8.0 and cannot be used. For this reason, screening levels for inorganics are based on the proposed Table D for TACO provided by the Illinois EPA which has screening levels for total inorganics in soil with a pH range of 4.5 to 9.0. There is not a pH dependent Tier 1 screening value for beryllium, cadmium, chromium, copper, lead, mercury, nickel, or zinc in Class II groundwater. Therefore, the metropolitan statistical area (MSA) background values presented in Section 742, Table G of TACO were used to screen beryllium, cadmium, copper, lead, mercury, nickel and zinc and the Class I groundwater-screening value was selected for chromium.

Table 13 presents the results for the 130 samples screened against Tier 1 screening levels for the migration to groundwater exposure route. Twelve (12) samples exceeded the TLC VOC screening levels. Forty (40) samples exceeded the TCL SVOC screening levels. The compounds that exceeded were benzene, toluene, ethylbenzene, and xylenes (BTEX), benzo(a)anthracene, benzo(b)fluoranthene, benzo(k)fluoranthene, benzo(a)pyrene, chrysene, dibenzo(a,h)anthracene, fluorene, indeno(1,2,3-cd)pyrene, naphthalene, nitrobenzene, n-nitrosodi-n-propylamine, phenol, 2,4-dimethylphenol, 2-methylphenol, and styrene. Benzene was the BTEX compound most often exceeding its respective Tier 1 screening level with a total of eleven (11) exceedences ranging from 0.825 to 130 mg/kg. Benzo(a)anthracene was the SVOC most often exceeding the TACO Tier 1 screening with a total of forty

(40) exceedances ranging from 8.91 to 4,140 mg/kg. As explained above, a pH value of 8.26 was used to determine the inorganic screening levels. When a screening value was not available, the MSA background soil concentration levels were used. These values are found in Table G of Appendix A of the approved TACO regulations. These screening levels produced exceedances for at least one total metal concentration in all the samples except four. Beryllium was the metal most often exceeding with a total of 132 exceedances ranging from 0.61 to 4.5 mg/kg. Lead exceeded the screening levels in seventy-eight (78) samples with a corresponding range of 37 mg/kg at SP036-001 to 550 mg/kg at SP059-002. Cadmium, chromium, copper, mercury, nickel, selenium, total cyanide and zinc also exceeded their respective screening level for several samples. The screening level for arsenic was exceeded only once at SP062-001 with a concentration of 140 mg/kg.

4.2.4 Ingestion of Class II Groundwater Exposure Route

The Class II groundwater ingestion exposure route Tier 1 screening levels were compared to groundwater sample results.

TACO Tier 1 screening levels for industrial/commercial properties are presented in Table 14. Out of the eleven (11) samples screened, benzene in the MW004 sample exceeded the Tier 1 screening level with a concentration of 0.16 mg/kg. Screening levels for benzo(a)anthracene, benzo(b)fluoranthene, benzo(k)fluoranthene, and indeno(1,2,3-cd)pyrene were exceeded in the MW004 sample. The screening level for naphthalene was exceeded in samples MW002, MW004 and MW009. The screening level for selenium was exceeded once in MW009. Total cyanide was exceeded in MW003, MW008 and MW009 samples.

4.3 FATE AND TRANSPORTATION OF CONSTITUENTS OF CONCERN

This section presents a qualitative evaluation of potential chemical migration pathways and describes the environmental behavior of chemicals that exceeded Tier 1 screening levels. Factors that influence chemical migration include location of source area and degree of concentration, physical integrity of source structures, geological and hydrogeologic conditions and physical and chemical characteristics. This section, which is based on criteria discussed in the preceding sections, focuses on chemical concentrations that exceed Tier 1 screening levels.

4.3.1 Potential Source Areas

Two potential source areas were identified: the southwest area and the north central area. Visual coal tar was also observed in a third area, but naphthalene was the only compound that exceeded TACO Tier 1 screening levels for industrial/commercial in this area (migration to groundwater exposure route). Impacted conditions within these areas were completely defined during the SI. As evidenced by the limited area of impacts, migration from these areas is assumed to be slow.

4.3.2 Potential Migration Pathways

The main migration pathway through the subsurface is through fractures in the brown/gray silty/clay layer. Tar found at the surface in the southwest section of the property has migrated down through the sand and gravel fill and entered the silty clay through the fractures. The gray silty clay has fewer fractures and minimized the migration of the tar further into the subsurface.

A sewer line runs north-south through the property east of the southwest impact area and is a potential preferential pathway. The top of the sewer line is approximately 6 feet bgs and is 18 feet by 14.4 feet in cross-section. The sewer is believed to be constructed of reinforced concrete. The filled in branch of the Chicago River also could act as a preferential pathway, but shows no signs of doing such.

4.3.3 Environmental Behavior of Chemicals of Interest

Chemicals of interest detected at the Crawford Station site are grouped into four basic categories: VOCs, SVOCs, priority pollutant metals, and cyanide. The following subsections describe how chemical properties of the compounds effect the behavior and distribution of the compounds in the environment.

4.3.3.1 VOCs

Volatile Organic Compounds have lower molecular weights; are less dense (lighter than water); have higher solubilities and vapor pressures (and therefore more volatility); and a lower affinity to bind to soil particles. The main VOCs of concern are benzene, toluene, ethyl benzene, and xylene (BTEX compounds).

The remaining discussions in this section will address VOC fate and transport primarily based on benzene data because BTEX compounds are similar in physical and chemical characteristics and more information is available concerning benzene's fate and transport.

The environmental fate of benzene under subsurface conditions is controlled by its relatively high solubility in water and low tendency to bind to organic matter. Because of these properties, benzene's presence in water is expected and will be of greater interest than PAHs' presence in water.

Advection is the most probable transport mechanism for benzene and other light aromatic compounds in the subsurface because most of light aromatics readily partition to groundwater. Naturally occurring biodegradation is likely to be the primary mechanism for benzene reduction in groundwater and subsurface soil. The presence of other hydrocarbons, such as naphthalene, is likely to enhance this process (Walker 1975).

4.3.3.2 SVOCs

Semi-Volatile Organic Compounds (SVOCs) consist of two separate groups of compounds, phenols and PAHs, all of which were analyzed for in each soil and water sample collected at the site.

Phenols are aromatic alcohols have lower molecular weights, higher water solubilities, higher vapor pressures and lower soil affinity than PAHs. Phenol is the indicator compound used in the environmental behavior discussion of phenols because phenolic compounds have similar chemical and physical properties.

Although phenols have higher vapor pressures than PAHs, their vapor pressures are relatively low and they have high solubilities; therefore, phenols tends not to volatilize from solution, especially at low concentrations.

Advection is the primary transport mechanism of phenol because of its high water solubility. Phenol is, however, rapidly and virtually completely biodegraded in soils and waters under both aerobic and anaerobic conditions.

PAHs are a class of organic compounds formed during incomplete combustion or pyrolysis of organic material containing carbon and hydrogen (USEPA 1985). PAHs generally have the following characteristics (ATSDR 1995):

- Multi-ringed aromatic organic compounds with densities greater than water.
- Low solubility in water.
- Low vapor pressures, explaining low volatility.
- Generally, low Henry's Law constants (also explains low volatility from water).
- High partition coefficients, explaining affinity for organic matter.
- Relatively low mobility, indicating these compounds are generally immobile.

Their low water solubility, low volatility and high affinity for binding to particulate or organic matter (ATSDR 1995) primarily define the environmental fate of PAHs. Dispersion is the primary transport mechanism of PAHs throughout the subsurface. Advective transport, or leaching, of PAHs is likely to be limited because of low water solubility and high soil adsorptivity of PAHs. The high affinity of PAHs to bind to organic matter and soil means that the occurrence of these contaminants in groundwater is expected to be limited (ATSDR 1995).

4.3.3.3 Metals

Metals in soils are expected to be less mobile because they form water-insoluble salts and are unable to form soluble complexes with humic and fulvic materials. However, under acidic conditions, some water-insoluble metal compounds may become soluble and move back into groundwater (USEPA 1984).

4.3.3.4 Cyanide

Cyanides are associated with spent oxides at MGP sites and generally exist in the environment as complex cyanide compounds. In water, cyanide occurs most commonly in the form of hydrogen cyanide; although, it can occur in ionic forms such as metallic cyanides. Volatilization and biodegradation are significant fate processes of hydrogen cyanide.

5.0 CONCLUSIONS

The overall objective of the former Crawford Station MGP, Properties A & B SI was to determine whether MGP-related constituents are present in surface soils, subsurface soils and groundwater and, if present, define the nature and extent of impacted areas.

5.1 SUFFICIENCY OF DATA

The objectives of the SI were met and the nature and extent of impacted areas were defined to the extent practicable.

5.2 RECOMMENDATIONS FOR FURTHER INVESTIGATION

Immediate remedial actions will be addressed in the forthcoming *Interim Remedial Action Plan (IRAP)*. The *IRAP* will present corrective measures proposed to eliminate or prevent exposure to MGP constituents and free product coal tar found at the site. Corrective measures may include removal of source materials and free product coal tar, removal of impacted surface soils, use of an engineered barrier, and/or adherence of existing city ordinances preventing the use of groundwater at the site.

* * * * *

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Table 1
Surface Soil Samples Collected for Chemical Analysis

Sample Number	Sample Depth (below ground surface)	Analyses
CEI-SP001-001	3-6 inches	-Target Compound List Volatile Organic Compounds (TCL VOCs), TCL Semi-Volatile Organic Compounds (SVOCs), priority pollutant metals, and total cyanide
CEI-SP002-001	0-1 foot	-TCL VOCs, TCL SVOCs, priority pollutant metals, and total cyanide
CEI-SP003-001	2-3 feet	-TCL VOCs, TCL SVOCs, priority pollutant metals, and total cyanide
CEI-SP004-001	0-3 inches	-TCL VOCs, TCL SVOCs, priority pollutant metals, and total cyanide
CEI-SP005-001	0-1 foot	-TCL VOCs, TCL SVOCs, priority pollutant metals, and total cyanide
CEI-SP006-001	1-2 feet	-TCL VOCs, TCL SVOCs, priority pollutant metals, and total cyanide
CEI-SP008-001	0-1 foot	-TCL VOCs, TCL SVOCs, priority pollutant metals, and total cyanide
CEI-SP009-001	2-3 feet	-TCL VOCs, TCL SVOCs, priority pollutant metals, and total cyanide
CEI-SP010-001	0-3 inches	-TCL VOCs, TCL SVOCs, priority pollutant metals, and total cyanide
CEI-SP011-001	1-2 feet	-TCL VOCs, TCL SVOCs, priority pollutant metals, and total cyanide
CEI-SP012-001	0-1 foot	-TCL VOCs, TCL SVOCs, priority pollutant metals, and total cyanide
CEI-SP013-001	2-3 feet	-TCL VOCs, TCL SVOCs, priority pollutant metals, and total cyanide
CEI-SP014-001	0-1 foot	-TCL VOCs, TCL SVOCs, priority pollutant metals, and total cyanide
CEI-SP015-001	0-3 inches	-TCL VOCs, TCL SVOCs, priority pollutant metals, and total cyanide
CEI-SP016-001	1-2 feet	-TCL VOCs, TCL SVOCs, priority pollutant metals, and total cyanide